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BURIED PREGLACIAL GROUND WATER CHANNELS IN THE ALBANY-SCHENECTADY AREA IN NEW YORK

by

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BURIED PREGLACIAL GROUND WATER CHANNELS IN THE ALBANY–SCHENECTADY AREA IN NEW YORK.[1]

E. S. SIMPSON.

ABSTRACT.

A map is presented showing contours of the buried preglacial channel of the Mohawk River from Schenectady, New York, to its confluence with the Hudson River about 12 miles south of Albany and of associated buried preglacial channels. The Pleistocene history of a portion of the Mohawk and Hudson Rivers is discussed, and the relation of buried valleys to ground-water supplies is indicated.

INTRODUCTION.

THE United States Geological Survey, in cooperation with the New York State Water Power and Control Commission, is making a general investigation of the ground-water resources of the Upstate areas of New York. The work is being conducted under the general supervision of M. L. Brashears, Jr., district geologist of the Ground Water Branch of the Geological Survey for New York and New England. The writer believes that the well data collected in Albany, Schenectady, and Saratoga Counties are sufficient to justify an attempt at constructing a contour map of the buried bedrock surface which would locate more precisely than heretofore the preglacial course of the lower Mohawk River and of other streams in the immediate vicinity.

The area treated is in the east-central part of New York State, south of the confluence of the Mohawk and Hudson Rivers. It includes the entire Albany quadrangle and the southern third of the Schenectady quadrangle, New York, and includes the cities of Albany and Schenectady.

Within the area treated the Mohawk River flows at an elevation of about 200 feet above sea level. The Hudson is only slightly above sea level and is affected by tides. The land surface north and east of Voorheesville (Fig. 1) is flat or gently rolling except where cut into by streams, and mostly lies at elevations between 200 and 400 feet above sea level. South and west of Voorheesville the land surface is hilly and rises towards the Helderberg escarpment.

All boring data used by the writer in the construction of Figure 1 have been obtained from the files of the U. S. Geological Survey and from records of wash borings published in the Deep Waterways Report of 1900.[2] A part of the records collected by the Geological Survey and used herein were obtained through interviews with well owners, many of whom supplied data

[1] Published with the approval of the Director of the U. S. Geological Survey.

[2] Report of the Board of Engineers on Deep Waterways: House of Rep. Doc. No. 149, G. P. O., 1900.

from memory. Although these records are believed to be essentially accurate, it is obvious that they cannot be guaranteed. The wash borings were driven to refusal and it appears likely that some of them were ended on boulders and not on bedrock.

PLEISTOCENE HISTORY.

It is believed that in pre-Pleistocene time the land area of what is now east-central and southeastern New York State stood at a much higher elevation in relation to sea level than is now the case. The Hudson River and its main tributaries, including the lower part of the Mohawk River, were youthful streams and actively downcutting their channels. Data presented in this paper and elsewhere [3] tend to show these channels to be relatively steep walled and deep enough so as perhaps to deserve to be called gorges. In the Albany-Schenectady area the development of the Hudson and Mohawk gorges may have taken place in two stages and a gorge within a gorge may exist, particularly in the Hudson Valley. The inner gorge, if a distinct and continuous inner gorge actually exists, must be very narrow. These features are shown in Figure 2.

Further development of the Mohawk-Hudson gorge was interrupted by subsidence of the land, which possibly may have coincided with the invasion of the continental ice sheet. After retreat and stagnation of the last ice sheet, the land has undergone uplift, but the magnitude of this uplift in the Albany-Schenectady area is slight in comparison to the magnitude of the preglacial and glacial subsidence. The gorge bottom, which must have been appreciably above sea level in the earlier time, is now several hundred feet below sea level.

Undoubtedly, prior to the time of burial, the Mohawk, Hudson, and other channels of the area must have been affected, to a greater or less degree, by ice erosion. From existing topographic evidence, the general direction of the movement of the last ice sheet in the Albany-Schenectady area seems to have been southerly to southwesterly, the southwesterly trend being more in evidence in the Schenectady section. Thus, the ice motion was more or less parallel to the axes of the Colonie channel and the Hudson channel (Fig. 1), whereas its trend was transverse to the direction of the Mohawk channel. In view of this, it would be expected that the sides of the Colonie and Hudson channels would have been over-steepened and widened by the ice, and that their floors, perhaps, would have been deepened.[4] Possibly the channels assumed the form of typical U-shaped glacial troughs. On the other hand, the Mohawk channel, because it lay athwart the direction of ice advance, would have undergone dissimilar and probably much less ice erosion. Indeed, the now-buried channel walls of the Mohawk seem less steep than those of the Hudson and Colonie (Fig. 1) and the accumulation of bottom till (hardpan) in the Mohawk channel seems to be greater. However, more data must be-

[3] Berkey, C. P., Geology of the New York City (Catskill) aqueduct: New York State Mus. Bull. 146, 1911.

[4] Berkey, C. P., op. cit., p. 95.

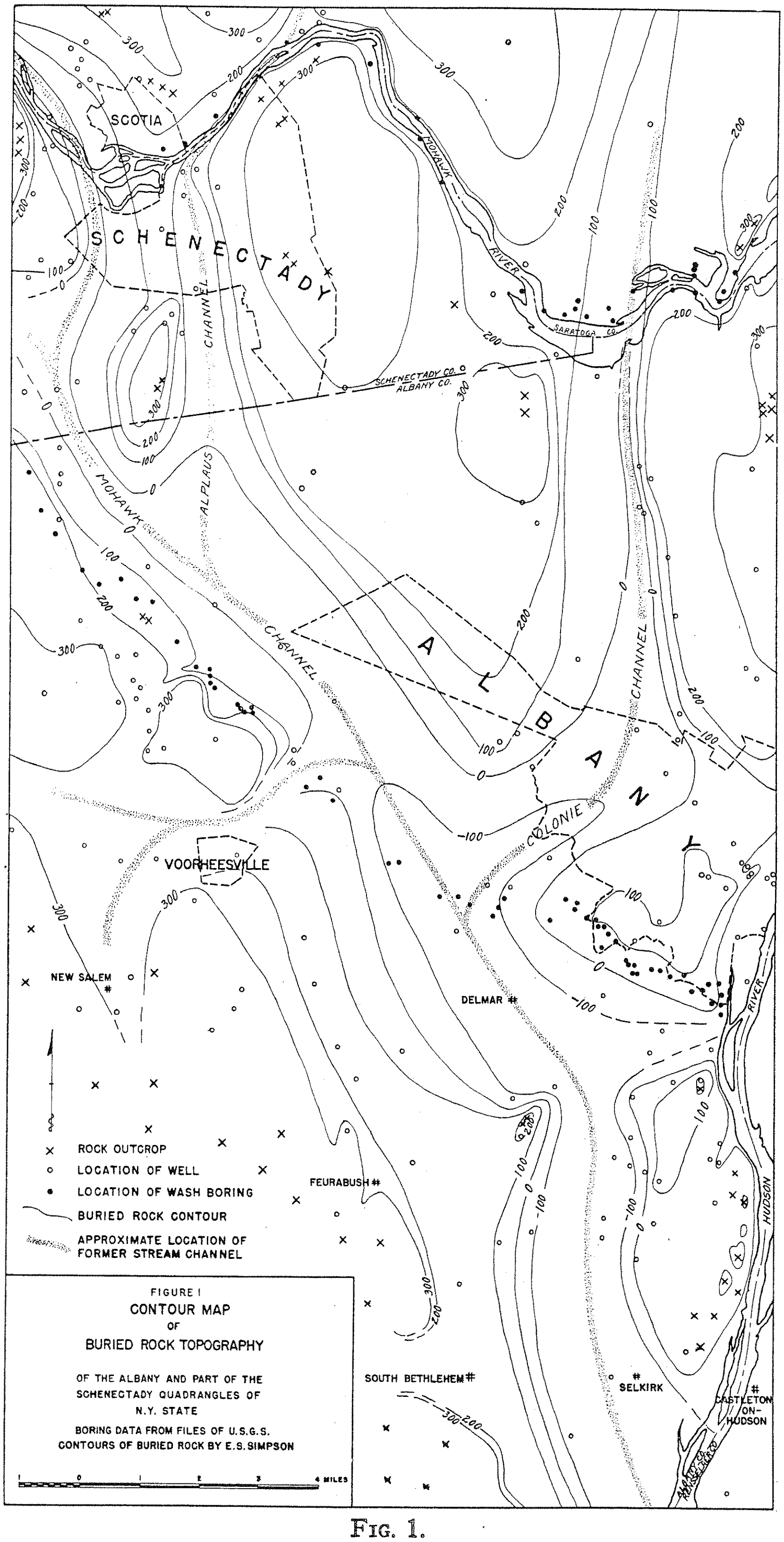
SCOTIA
SCHENECTADY
MOHAWK RIVER
SARATOGA CO.
SCHENECTADY CO.
ALBANY CO.
ALPLAUS CHANNEL
MOHAWK CHANNEL
CHANNEL
ALBANY
COLONIE
VOORHEESVILLE
NEW SALEM
DELMAR
FEURABUSH
SOUTH BETHLEHEM
SELKIRK
CASTLETON ON-HUDSON
HUDSON RIVER
ROCK OUTCROP
LOCATION OF WELL
LOCATION OF WASH BORING
BURIED ROCK CONTOUR
APPROXIMATE LOCATION OF FORMER STREAM CHANNEL
FIGURE I
CONTOUR MAP OF BURIED ROCK TOPOGRAPHY
OF THE ALBANY AND PART OF THE SCHENECTADY QUADRANGLES OF N.Y. STATE
BORING DATA FROM FILES OF U.S.G.S.
CONTOURS OF BURIED ROCK BY E.S.SIMPSON
4 MILES

FIG. 1.

come available before it is possible to make statements with confidence concerning the effects of ice erosion on the buried channels.

Although there was probably more than one advance and retreat of the ice front over the area during Pleistocene time, it is to the final ice sheet of the Wisconsin stage that most of the débris now found mantling the bedrock in the Albany-Schenectady area is attributed. In the opinion of the writer the till in the Mohawk channel must have been derived almost entirely, if not entirely, from the ice sheet of the Wisconsin stage, because only one till, which lies directly over bedrock, has been observed in the area. Till was deposited almost everywhere in this area under the moving ice sheet and in places reached a thickness of about a hundred feet.

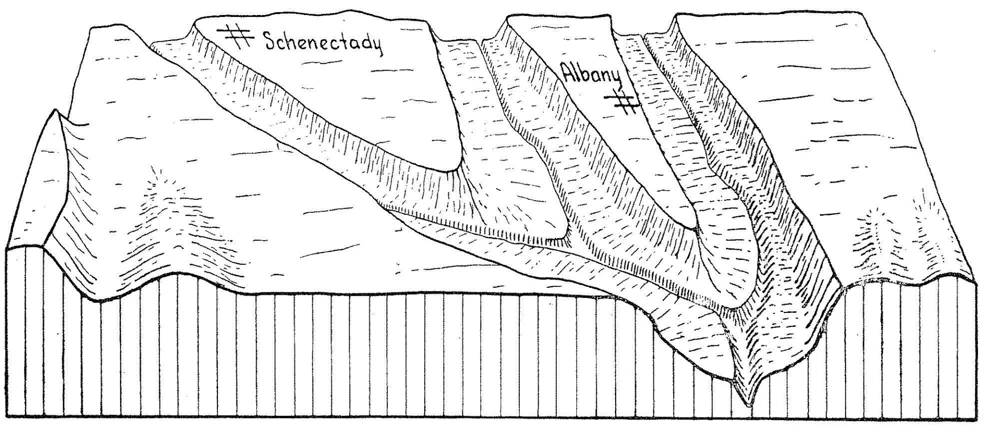

FIG. 2. Block diagram showing possible bedrock topography in the Albany-Schenectady area (Diagram modified after Cook, J. H., Chapter on glacial geology, *in* Geology of the Capital District, by Rudolf Ruedemann; New York State Mus. Bull. 285, p. 188, 1930).

During part of the final stagnation of Wisconsin ice, there existed over much of the Albany-Schenectady area a glacial lake which Woodworth [5] has called Lake Albany. The approximate outline of this lake in the Albany-Schenectady area is shown on the map (Fig. 1) by the 300-foot contour line. Glacial outwash was deposited in this lake, a large part of it as deltas of varying size and character. Much of these sediments were transported to the Albany-Schenectady part of the lake from the west, and especially large amounts were deposited during the time that the Mohawk drained the glacial Great Lakes.

The history of deposition was not simple. In general (and without attempting any correlation), considering first the deposits in the Mohawk channel, cross-bedded gravel and sand was deposited upon till in the Scotia area, sands were deposited over the clay and till west of Albany, and chiefly clays were deposited on till south of Albany. The northward extension of the Colonie channel probably carried outwash to Lake Albany from areas to the north. This outwash very likely provided a large portion of the fill which

[5] Woodworth, J. B., Ancient water levels of the Champlain and Hudson Valleys: New York State Mus. Bull. 84, p. 175, 1905.

now occupies the Colonie channel between Albany and the present-day Mohawk River. This fill is much more irregular than that which occupies the Mohawk channel. It is coarsest to the north; to the south, in the vicinity of Albany, it consists chiefly of clay. A deposit of gravel, in places about 60 feet thick, is found in and near the villages of Voorheesville and New Salem.

From these and other sources, material was washed into Lake Albany in sufficient quantity to obliterate all, or nearly all, of the preglacial drainage pattern below about the 300-foot contour in the Schenectady-Albany area.

When Lake Albany was drained the Mohawk River downstream from Schenectady failed to reoccupy its old channel. Instead, it zigzagged eastward, cutting a new channel in part through glacial débris and in part through consolidated rock. Where the channel is in glacial débris the river is relatively wide and its banks have gentle slopes, but where the channel lies in rock the river is narrow and the walls often precipitous.

THE BURIED CHANNELS.

Of the buried channels shown on Figure 1, three are fairly well substantiated by available data. These are here named the Mohawk channel, the Alplaus channel, and the Colonie channel. The existence of each of these channels has been recognized heretofore [6] but their locations have remained vague and unknown. Cook [7] believed the buried Mohawk channel to join the Hudson near Albany instead of about 12 miles south of Albany, as believed by the writer. The well records also suggest the existence of two other channels which have not been named. Evidence of their existence is presented here for the first time. One joins the Mohawk channel southwest of Schenectady and the other joins the Mohawk channel northeast of Voorheesville.

The buried channel of the Mohawk continues upstream from Schenectady (and off the map) for about 8 miles to Hoffmans, New York. The channel fill in this reach is about 200 feet thick and the existing Mohawk River meanders over its surface. At Hoffmans the Hoffmans fault intersects the river and in preglacial time was probably the site of a waterfall about 100 feet high. Where it crosses the river, the west, upthrown side of the fault is capped by beds of relatively resistant Little Falls dolomite of Upper Cambrian age. The downthrown side consists largely of weak shales of the Middle Ordovician Schenectady formation. The average gradient of the buried Mohawk channel from Hoffmans to its confluence with the Colonie channel is probably about 8 or 9 feet per mile.

There is evidence based on a study of well logs that an inner notch exists in the buried Mohawk channel from Hoffmans to its confluence with the present Hudson River somewhere south of Selkirk. The elevation of bedrock at, and downstream from, the confluence of the Mohawk and Colonie channels is shown to be about 100 feet below sea level (Fig. 1). However, at this

[6] Cook, J. H., Some preglacial valleys in eastern New York and their relation to existing drainage (abst.): Science, new ser., vol. 29, p. 750, 1909.

Stoller, J. H., Glacial geology of the Schenectady quadrangle: New York State Mus. Bull. 154, p. 12, 1911.

[7] Cook, J. H., Chapter on glacial geology, *in* Geology of the Capital District, by Rudolf Ruedemann: New York State Mus. Bull. 285, p. 188, 1930.

elevation the channel probably is part of the inner notch mentioned, and must be relatively narrow. Because boring data are insufficient to locate it precisely, the —100 foot contour is drawn to show the entire range of possible positions that the inner notch might occupy.

The northward extension of the Colonie channel is believed by Stoller [8] to have included a rock depression now occupied in part by Round Lake and by Saratoga Lake. The continuation of this channel northward of Saratoga Lake is obscure, but it is possible that it reached northward and westward to drain part of the southeast slope of the Adirondack Mountains. The part of the channel shown on Figure 1 seems relatively steep walled and suggests a typical glacial trough.

At the north end of Saratoga Lake, about 12 miles north of the northern boundary of Figure 1, a well boring shows bedrock to be at about 45 feet above sea level. Unless the bedrock at this location was locally overdeepened by ice erosion, this boring suggests the existence of a continuous buried stream channel from the north end of Saratoga Lake to a confluence with the buried Mohawk channel south of Albany, its average gradient between these places approximating 6 feet per mile. Thus the Colonie channel may have carried the master stream of the area in preglacial time, since this gradient seems flatter than any of the others, including, perhaps, the gradient of the buried channel occupied by the present Hudson River in the Albany area. Indeed, the boring mentioned and the topography north of Albany suggest that the buried channel under the Hudson at Albany formerly drained the Hoosic and Batten Kill watersheds (as is now the case), but did not extend much north of Batten Kill, and that the Lake Champlain and Lake George watersheds were drained by southward-flowing streams that intersected the existing Hudson near Fort Edward and west of Glens Falls, respectively, and may have continued on to the buried valley the writer has named the Colonie channel.

The Alplaus channel is much smaller than the Colonie and Mohawk channels, and consequently its pre-Pleistocene watershed was probably of relatively limited extent. Stoller [9] believes that the northward extension of the Alplaus channel included what is now Ballston Lake, and also that it branched off westward to drain part of Glenville Hill. Its average gradient seems to be about 15 feet per mile for the portion contoured.

In the Albany area the available data are insufficient to indicate the depth of fill under the existing Hudson River. In the downtown business section of the city of Albany, about 1,000 feet west of the river, borings show bedrock to be about 50 feet below sea level, and in the city of Rensselaer, on the east bank of the river opposite Albany, borings show bedrock to be about at sea level or higher. Inasmuch as borings in the buried Mohawk-Colonie channel, about 5 miles upstream from its confluence with the existing Hudson River and about 7 miles south of Albany, show bedrock at 190 feet below sea level, we are faced with the following possibilities:

[8] Op. cit., p. 12.
[9] Op. cit., p. 12.

(1) Bedrock under that portion of the existing Hudson River shown on Figure 1 is also about 190 feet below sea level.

(2) The buried Mohawk-Colonie channel was overdeepened by ice erosion which did not affect the buried Hudson channel to an equal degree.

(3) The preglacial stream that occupied the buried channel over which the existing Hudson now flows in the vicinity of Albany had a smaller flow (less erosive power) upstream from its confluence with the preglacial Mohawk, than did the preglacial Mohawk.

Present-day records of stream flow [10] show that the average discharge of the Hudson River at Mechanicville (about 20 miles upstream from Albany and about 10 miles upstream from its confluence with the existing Mohawk River) is about 7,400 cubic feet per second, whereas the average discharge of the Mohawk River at Cohoes (which is near its confluence with the Hudson) is about 5,600 cubic feet per second. Thus the present-day Hudson is clearly the larger stream.

A study of the existing topography of east-central and northeastern New York makes it evident that, in preglacial time, a large master stream existed which drained a basin as large, if not larger, than that drained by the present-day Hudson above its confluence with the Mohawk River. This preglacial stream must have flowed southward near what is now Albany. Thus it may well be that the preglacial Hudson occupied a different channel in the vicinity of Albany than is now the case. Perhaps this channel was the Colonie channel as shown on Figure 1. A further study of existing data and the accumulation of new data may be necessary to decide the issue.

GROUND-WATER SUPPLIES FROM BURIED VALLEYS.

The location and mapping of buried channels, such as presented in this paper, have economic as well as academic interest. Perhaps the aspect of the problem of greatest economic importance is the relation of buried channels to the occurrence of ground water. Glacial outwash, filling the rock channels of rivers, in many places provides the source from which tens of millions of gallons of water may be pumped daily.

In the area shown on Figure 1, the most favorable opportunity for obtaining large supplies of ground water lies in the Pleistocene gravel delta deposit that partly fills the Mohawk channel south and west of Scotia. The withdrawal from these gravels is, at present, in excess of 20 million gallons a day, and it is likely that the ground-water pumpage will be nearly doubled in the near future, owing to increased industrial use by plants presently under construction, and to wider domestic use through the contemplated formation of new municipal water systems. Available data show that the downstream periphery of this delta is sharply delineated, and that the municipal supply wells of the city of Schenectady, which account for most of the pumpage from this well field, are within 1,500 feet of the periphery.

[10] U. S. Geol. Survey Water Supply Paper 1031, Surface water supply of the United States, pt. 1, pp. 255, 276, 1945.

The Colonie channel, athough a less favorable area for the development of ground-water supplies than the Mohawk channel near Scotia, nevertheless provides in excess of 2 million gallons a day for the Latham Water District of the town of Colonie. There are also several hundred domestic and industrial wells deriving their supply from outwash in the Colonie channel.

A small public water-supply system obtains ground water from wells penetrating the gravels near New Salem, and several industrial wells in and near Voorheesville penetrate what may be the same gravel deposit.

The sands underlying the plain that forms the land surface over much of the area of glacial Lake Albany are tapped by several thousand shallow domestic wells. Unfortunately, in many places this sand is of insufficient thickness to provide a dependable water supply in late summer and early fall. In addition, hundreds of domestic wells and a number of industrial wells scattered over the remainder of the area depend on glacial drift of different types for their entire supply.

Except for a relatively small area shown in the southwestern part of Figure 1, where the Manlius limestone of Silurian age and several limestones of Devonian age are found, there is no bedrock aquifer capable of yielding more than about 10 gallons of potable water per minute to any well, no matter how deep. Future ground-water development in the highly populated and industrialized Albany-Schenectady area must therefore continue to depend on glacial outwash for its source of supply.

The trend toward increased consumption of ground water for industrial and other uses is evident in the Albany-Schenectady area, as elsewhere. The supply is large but in no case is it unlimited, and there can be little doubt that all possible sources will receive closer study as time goes by. Many buried channels in New York and New England, such as those described in this paper, are capable of yielding large and convenient supplies of ground water, and, therefore, deserve continued and close study on the part of water-supply geologists and engineers.

U. S. Geological Survey,
Albany, N. Y.,
July 8, 1949.